

## **What is Claimed Is:**

1. A method for ventilating an inside space using an HVAC system, the HVAC system adapted to respond to system calls for controlling one or more environmental conditions of the inside space, the HVAC system including a fan to distribute air to the inside space, and further including a fresh air intake that can be opened and closed, the method comprising:

determining a fraction of time that the fresh air intake must be open during anticipated future system calls of the HVAC system to meet a desired ventilation threshold for the inside space by the end of a predetermined time period; and

opening the fresh air intake by the fraction determined in the determining step during one or more subsequent system calls of the HVAC system.

2. A method according to claim 1, further comprising the step of:  
updating over time the fraction of time that the fresh air intake must be open during anticipated future system calls of the HVAC system to meet a desired ventilation threshold for the inside space.

3. A method according to claim 1, further comprising the step of:  
providing a fresh air ventilation call to the HVAC system, and opening the fresh air intake, if the fraction exceeds a predetermined value.

4. A method according to claim 3, further comprising the step of:  
providing two or more fresh air ventilation calls over time to the HVAC system if the fraction exceeds the predetermined value two or more times over time.

5. A method according to claim 3 further comprising the step of smoothing out the two or more fresh air ventilation calls over time.

6. A method according to claim 5 wherein the smoothing step comprises increasing the fresh air ventilation at selected times and/or decreasing the fresh air ventilation at selected times.

7. A method for operating an HVAC system that is adapted to respond to system calls to control one or more environmental conditions of an inside space, the HVAC system including a fan to distribute air to the inside space, and further including a fresh air intake, the method comprising:

anticipating a future cycling time of the fan of the HVAC system due to anticipated system calls of the HVAC system;

comparing the anticipated cycling time of the fan to a desired ventilation threshold; and

operating the fan with the fresh air intake open when no other HVAC system call is activated if the anticipated fan cycling time of the fan is insufficient to meet the desired ventilation threshold.

8. The method of claim 7 wherein the fresh air intake can be opened and closed, and if the anticipated future fan cycling time of the fan is sufficient to meet the desired ventilation threshold, the method further comprising:

determining a ratio of selective fresh air intake open time to fan on time, for the anticipated fan cycling time of the fan that result from anticipated system calls of the HVAC system, which is related to a time that the fresh air intake should be open to meet the ventilation threshold; and

sending one or more signals to open and close the fresh air intake in accordance with the ratio during at least one subsequently experienced system call of the HVAC system while the fan is on.

9. The method of claim 8 further comprising the step of:

observing a ventilation history of the HVAC system and determining whether a predetermined sufficient amount of ventilation has occurred during a first past time period; and

reducing the ratio if over-ventilation occurred during the first time period.

10. The method according to claim 8 further comprising the step of increasing the ratio if under-ventilation occurred during the first time period.

11. A method of controlling an HVAC system, the HVAC system including an air moving apparatus, a call device capable of calling for air movement by the air moving apparatus, and a ventilation controller adapted to receive a call from the call device and coupled to the air moving apparatus, the ventilation controller also coupled to a selective fresh air source, the method adapted for achieving fresh air ventilation sufficient to meet one or more FAV thresholds, the method comprising:

gathering a ventilation history over a first time period, wherein the first time period includes a number of second time periods ending with a present time period that is a second time period that has not yet expired;

analyzing the ventilation history by:

determining a non-call amount of time for each of the second time periods that the HVAC system operated the air moving apparatus without receiving a call from the call device;

subtracting an average ventilation time from the non-call amount of time for each second time period to create a difference for each second time period wherein the average ventilation time is determined from an FAV threshold that calls for an FAV rate, the average ventilation time being determined by multiplying the length of time of a second time period by the FAV rate; and

sequentially, beginning with a most recent second time period and ending at the earliest second time period in the first time period, creating a sum of the differences wherein, within the sequence of calculating the sum, the sum is never less than zero;

comparing the amount of time left in the present time period to the sum; and  
if the amount of time left in the present time period is less than the sum:

opening the selective fresh air source; and

operating the air motivation apparatus.

12. A method of operating an HVAC system having an air moving apparatus to satisfy a desired fresh air ventilation threshold including a shorter time duration requirement and a longer time duration requirement, the method comprising:

keeping a selective fresh air source selected whenever the air moving apparatus is activated due to a call for a temperature change in a controlled space unless, during a given time period:

the shorter time duration requirement is satisfied; and

the total fresh air ventilation requirement for the longer time duration requirement is met and exceeded by an amount greater than a predefined over ventilation limit during the time period and an amount of time prior to the time period sufficient to meet the duration of the longer time duration requirement;

wherein the predefined over ventilation limit is equal to or greater than zero.

13. A method of operating an HVAC system having a fresh air source, an air moving apparatus and a call device adapted to call for operation of the air moving apparatus, the method adapted to satisfy a desired fresh air ventilation (FAV) threshold, the method comprising:

defining a first time period;

determining whether the air moving apparatus must be operated to satisfy the FAV threshold for the first time period and, if so, activating the air moving apparatus and accessing the fresh air source.

14. The method according to claim 13 wherein the fresh air source is a selectable fresh air source, the method further comprising:

determining whether the call device is calling for operation of the air moving apparatus;

determining whether all requirements of the FAV threshold have been and/or will be satisfied; and, if so, deselecting the fresh air source.

15. A method of operating an HVAC system having a fresh air source, an air moving apparatus, and a call device adapted to call for operation of the air moving apparatus in response to an environmental condition in a space controlled by the HVAC system, the HVAC system further including a selectable fresh air source, the method being adapted to meet a fresh air ventilation (FAV) threshold, the method comprising:

analyzing a period of time of operation of the HVAC system related to a length of time for which an FAV threshold is applicable, the period of time beginning at a first time and ending at a second time, with the second time occurring during a current time period, wherein the step of analyzing includes determining whether and for how long the air moving apparatus has been operated during non-call time in which the air moving apparatus is operated without a call for heating, cooling, humidification or dehumidification within the space;

comparing the non-call time to a predetermined level;

calculating a smoothing function time related to the non-call time; and

if the smoothing function time related to the non-call time exceeds a predefined amount of time operating the air moving apparatus with access to the fresh air source during the current time period.

16. The method of claim 15 wherein the smoothing function time is calculated by:

dividing the period of time of operation of the HVAC system into a number of time periods beginning with a first time period and ending with the current time period; and

chronologically adding together the difference between the non-call time in a time period and a predefined time for each time period beginning with the current time period and ending with the first time period, such that, if after any step in the chronological addition, the sum of the differences becomes negative the sum is reset as zero before adding the next difference.

17. The method of claim 16 wherein there are N time periods from the first time period to the current time period, inclusive, and wherein the duration of the length of

time to which the at least one FAV requirement is applicable is equal to N+1 time periods.

18. A method of satisfying a collection of one or more fresh air ventilation (FAV) thresholds using an HVAC system, the HVAC system including an air moving apparatus, a call device capable of selectively calling for activation of the air moving apparatus, and a fresh air source, the method comprising:

determining whether each ventilation threshold has been met, and, if any ventilation threshold is unmet, determining whether fresh air ventilation must begin in order to meet any unmet ventilation threshold;

if so, causing fresh air ventilation; and

if not:

observing a ventilation history for the HVAC system.

19. The method of claim 18 further comprising:

determining whether the duration and/or spacing of past fresh air ventilation satisfies a predetermined condition.

20. The method of claim 19 further comprising:

if the FAV duration and/or FAV spacing does not satisfy the predetermined condition, determining whether beginning ventilation will improve the FAV duration and/or FAV spacing, and, if beginning ventilation will improve the FAV duration and/or the FAV spacing, causing fresh air ventilation to occur.

21. The method of claim 20 wherein the FAV thresholds including a first threshold for a first duration of time, a second threshold for a second duration of time, and a third threshold for a third duration of time, the first duration being shorter than the second duration and the second duration being shorter than the third duration, the method further comprising:

determining when in the ventilation history non-call activations occurred where the air moving apparatus was activated without the call device making a call for heating, cooling, humidification and/or dehumidification; and

wherein the step of determining whether the duration and/or spacing of past fresh air ventilation satisfies the predetermined condition includes:

dividing a portion of the ventilation history into a number of time blocks; and

observing whether, within any of the time blocks, non-call activations lasted for a duration exceeding an average FAV for a time block that is caused by any of the first, second or third thresholds.

22. A method of satisfying a fresh air ventilation (FAV) threshold using an HVAC system, the HVAC system including an air moving apparatus, a call device capable of selectively calling for activation of the air moving apparatus, and a selectable fresh air source, the method comprising:

selecting the fresh air source when the air moving apparatus is operated by the HVAC system unless an over ventilation threshold has been satisfied;

wherein the over ventilation threshold is satisfied if the total amount of ventilation occurring in a first time period is greater than the total ventilation time called to meet the fresh air ventilation (FAV) threshold multiplied by an over ventilation limit.

23. The method of claim 22 wherein the over ventilation limit is greater than or equal to one.

24. The method of claim 23 wherein the over ventilation limit is determined by use of the following formula:

$$\text{Over Ventilation Limit} = 1 + \frac{\text{total\_fantime}}{\text{fresh air ventilation}}$$

wherein total\_fantime is defined as the amount of time during the first time period that the air moving apparatus has been operated without receiving a call from the call device to satisfy an environmental condition other than ventilation, and fresh air

ventilation is defined as the amount of ventilation time called to the air moving apparatus to meet the fresh air ventilation (FAV) threshold.

25. The method of claim 22 wherein the over ventilation limit is set equal to a predetermined value.

26. A control device for placement in an HVAC system, the HVAC system including an air moving apparatus and a device producing an air moving apparatus control signal, the control device comprising:

- a receiving pin for receiving the air moving apparatus control signal;

- a sending pin for sending a signal to the air moving apparatus;

- a controller adapted to perform the following functions:

- observe whether an ON signal is received at the receiving pin, and, if so:

- allow the ON signal to propagate out to the sending pin and to the air moving apparatus; and

- record the amount of time the ON signal is sent to the air moving apparatus; and

- determine whether sufficient ventilation has occurred during a first time period to meet a ventilation threshold and:

- if not, cause the air moving apparatus to be ON with access to a fresh air source.

27. The control device of claim 26 wherein the fresh air source is a selectable fresh air source, the method further comprising the step of:

- if sufficient ventilation has occurred during a first time period to meet a ventilation threshold, causing the selectable fresh air source to be closed.

28. The control device of claim 26 wherein the control device is adapted to be placed along a control signal path from a sensing device to an existing HVAC system control device.



29. The control device of claim 26 wherein the control device is adapted to be placed along a control signal path from an existing HVAC system control device to the air moving apparatus.

30. A device adapted for use with an HVAC system, the HVAC system comprising an environmental sensor adapted to signal a call for environmental change within a controlled space, an air moving apparatus, an environmental modifying apparatus, and a fresh air ventilation (FAV) damper, the device comprising:

one or more inputs for receiving one or more signal from the environmental sensor;

one or more outputs for sending one or more signals to the air moving apparatus and the FAV damper; and

a controller adapted to determining a fraction of time that the fresh air ventilation (FAV) damper must be open during anticipated future calls to meet a desired ventilation threshold for the controlled space by the end of a predetermined time period, and further adapted to send a signal to open the fresh air ventilation (FAV) damper according to the determined fraction of time during one or more subsequent calls.

31. A device according to claim 30, wherein the controller is further adapted to update over time the fraction that the fresh air ventilation (FAV) damper must be open during anticipated future calls to meet a desired ventilation threshold for the controlled space.

32. A device according to claim 31, wherein the controller is further adapted to provide a fresh air ventilation call to the air moving apparatus of the HVAC system, and opening the fresh air ventilation (FAV) damper, if the fraction exceeds a predetermined value.

33. A device according to claim 32, wherein the controller is further adapted to provide two or more fresh air ventilation calls to the air moving apparatus of the HVAC system if the fraction exceeds the predetermined value two or more times.

34. A device according to claim 33, wherein the controller is further adapted to smooth out the two or more fresh air ventilation calls over time.

35. A device according to claim 34, wherein the controller smoothes out the two or more fresh air ventilation calls over time by increasing the fresh air ventilation at selected times, and decreasing the fresh air ventilation at other selected times.

36. A furnace fan board for use with an HVAC system, the HVAC system having an environmental sensor adapted to signal a call for environmental change within a controlled space, and an FAV damper, the furnace fan board configured to control a fan for use with the HVAC system, the furnace fan board comprising:

- a number of ports for receiving signals from the environmental sensor;
- an output port for sending a signal to control the FAV damper; and
- a controller adapted to determine whether the FAV damper should be opened or closed to meet a chosen FAV threshold.

37. A furnace fan board for use with an HVAC system, the HVAC system having an environmental sensor adapted to signal a call for environmental change within a controlled space, the furnace fan board configured to control a fan for use with the HVAC system, the furnace fan board comprising:

- a number of ports for receiving signals from the environmental sensor;
- a controller adapted to determine whether the furnace fan should be operated to meet a chosen FAV standard.

38. A method of operating an HVAC system comprising:  
providing a device allowing a user to select from at least a first collection of one or more ventilation goals and a second collection of one or more ventilation goals;

operating the HVAC system in a manner designed to meet the first collection of ventilation goals if the user selected the first collection of ventilation goals; and

operating the HVAC system in a manner designed to meet the second collection of ventilation goals if the user selected the second collection of ventilation goals.

39. A method according to claim 38 wherein the device is a switch.

40. A method according to claim 39 wherein the device is a DIP switch.

41. A method according to claim 39 wherein the device is a user interface.

42. A method according to claim 41 wherein the user interface includes a dot matrix display.

43. A method according to claim 41 wherein the user interface includes an LCD display.

44. A method of operating an HVAC system comprising:  
providing two or more different control methods to meet the same ventilation goal;  
allowing the user and/or installer to select one of the control methods, resulting in a selected control method; and  
operating the HVAC system in accordance with the selected control method.

45. A method of operating an HVAC system comprising:  
providing two or more different control methods, each adapted to meet a different ventilation goal;  
allowing the user and/or installer to select one of the control methods, resulting in a selected control method; and  
operating the HVAC system in accordance with the selected control method.

46. A method of operating an HVAC system comprising:  
providing a control method to meet a ventilation goal, the control method including two or more parts;  
allowing the user and/or installer to disable and/or enable one or more parts of the control method, resulting in a selected control method; and  
operating the HVAC system in accordance with the selected control method.

47. An HVAC controller, comprising:  
a memory for storing two or more control methods, each adapted to meet a different ventilation goal;  
selecting device for allowing a user and/or installer to select one of the control methods, resulting in a selected control method; and  
a controller coupled to the selecting device and the memory, the controller adapted to operate an HVAC system in accordance with the selected control method.